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CABBAGE PRODUCTION IN CALIFORNIA

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Cabbage is a cool-season crop, making its best development in those localities where it can grow to maturity under moderately humid conditions and where the temperature is cool and equable. In California cabbage does best on the coast and in the bay regions where the climate is subject to the modifying influence of large bodies of water. In these regions it grows well throughout most of the year. In the interior valleys the crop is grown mainly during the fall, winter and early spring.

SEASONS OF PRODUCTION

Cabbage is grown chiefly for local consumption, but some localities produce a considerable amount for distant shipment. Most of the cabbage shipped in carload lots from California is moved between December and the middle of June. This brings the California crop into competition with the late crop that is kept in storage in New York and Wisconsin and with the early crop from the southern states. By the end of March the stored product has been almost entirely moved, but Alabama, Florida, Louisiana, South Carolina and Texas ship enormous quantities north and keep the market well supplied until the middle of May or first of June. Then the early crop starts to move from Maryland, New Jersey, Ohio, Virginia, and Tennessee. If the northern late crop is below the average, or if the southern acreage is small or the yield low, there should be a strong demand for California cabbage at a price that will make eastern shipment profitable. Figure 1 shows the average farm price of cabbage for the United States on the 15th of each month for a period of 15 years, 1910 to 1924 inclusive. The peak of prices is usually reached during May and June. This is near the end of the Florida, South Carolina

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and Texas shipments and before the early crop of the north is on the market. During this period, Virginia, Maryland, Ohio, Mississippi and Tennessee are the heaviest shippers. It is at this time that California must put cabbage on the markets of the East if profitable returns are to be expected over a series of years. During July and August, the large northern and eastern markets are fairly well supplied by the local growers, which accounts largely for the falling off in carlot shipments during mid-summer.

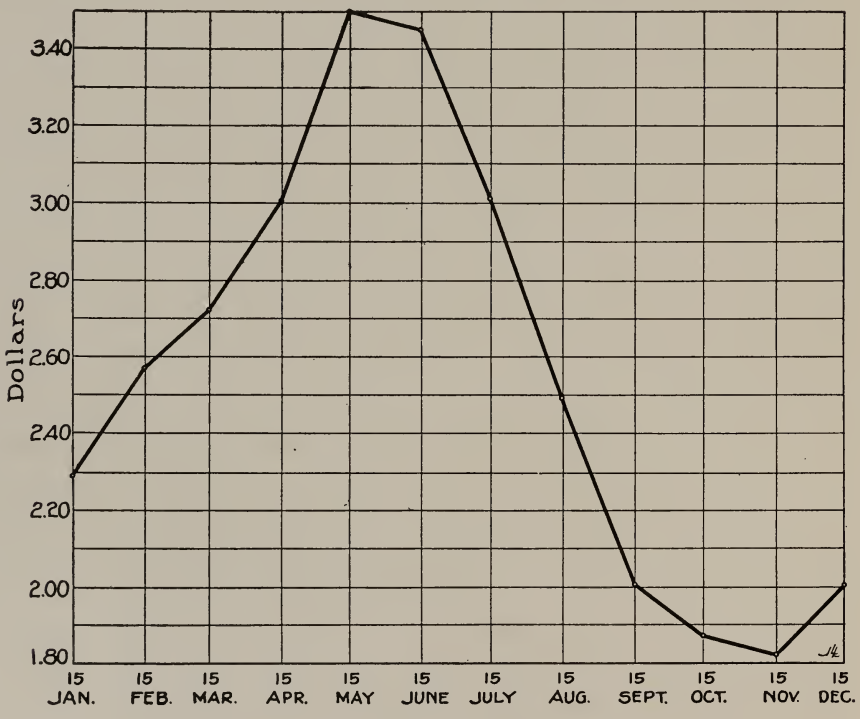

Fig. 1.—Average farm price in the United States per 100 pounds of cabbage on the 15th of each month for the years 1910 to 1924 inclusive. (Data from U. S. D. A. Yearbook.

In figure 2 are charted the periods of shipment of the most important cabbage producing states and districts, showing the relation they bear to one another. From this diagram it can be seen at once which are the main competing areas.

In table 1 is given the carlot shipments of cabbage by months for the entire country. A considerable decrease in carlot shipments takes place during July and August. The demand is usually taken care of by home grown supplies during this period, which accounts for the small carlot movements.

The large cabbage growing districts are pretty well defined, the principal ones being in the northern states. The most extensive cabbage district in the United States is in the state of New York and lies between the cities of Buffalo and Syracuse. About one-fourth of

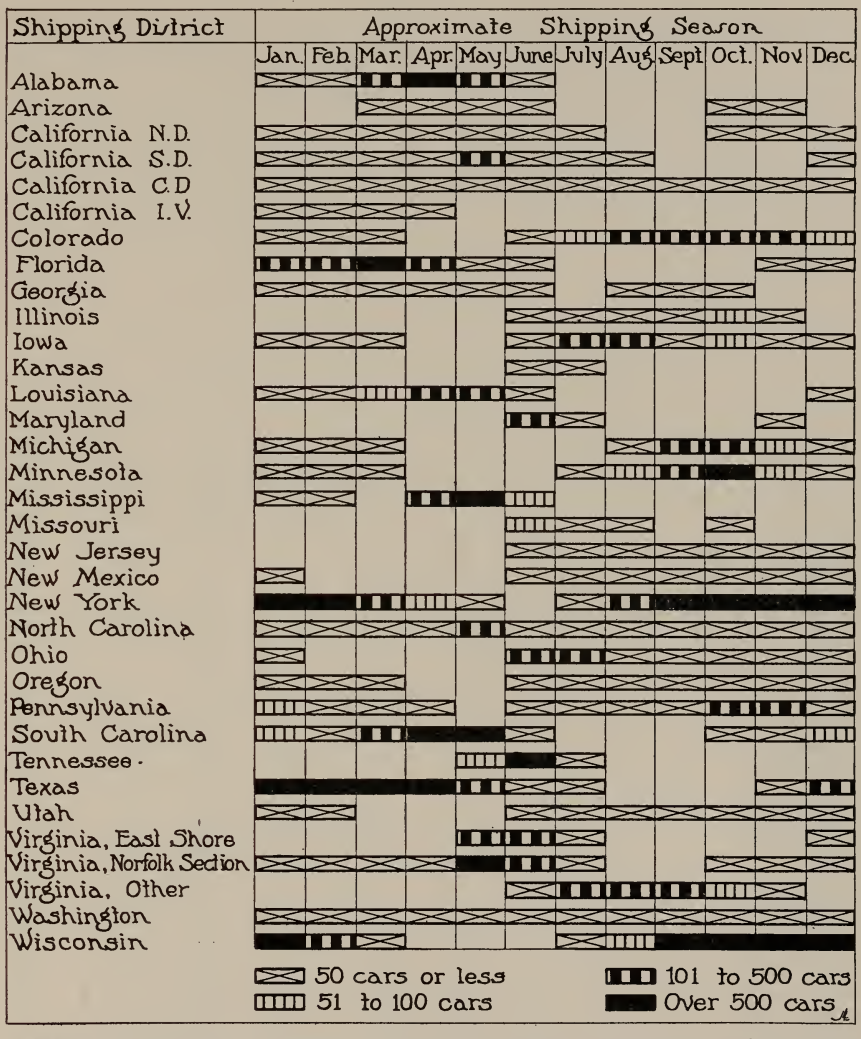

Fig. 2.—Periods of shipment of the important cabbage producing states; average for the years 1925 to 1927. The abbreviations in California are N.D., Northern District; S.D., Southern District; C.D., Central District; I.V., Imperial Valley. (Data from Bureau of Agricultural Economics.)

the acreage of the entire country is found in this district. Other important areas of production are Long Island, New York; around Norfolk and in Wythe County, Virginia; along Lake Michigan from Chicago to Milwaukee; between Denver and Greeley, Colorado; in

TABLE 1

CARLOT SHIPMENTS OF CABBAGE BY MONTHS FOR THE UNITED STATES, 1922–1927.
(Data from Bureau of Agricultural Economics.)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1922	3,346	3,422	4,185	3,831	4,010	2,253	660	1,436	3,523	7,060	3,824	2,528
1923	2,985	2,299	2,630	3,779	4,135	2,234	853	1,603	3,384	6,760	4,211	2,389
1924	4,097	3,665	4,565	3,365	3,722	2,462	1,028	1,496	3,559	6,165	4,576	2,415
1925	4,075	3,597	3,804	4,142	3,660	1,784	666	1,270	4,021	6,750	3,595	2,592
1926	3,619	2,947	3,418	4,079	4,444	2,769	850	1,114	3,368	6,453	4,094	323
1927*	4,275	3,051	4,341	3,960	2,087	2,459	705	1,218	3,504	6,134	3,747	2,517
6-yr. avrge...	3,733	3,164	3,824	3,859	3,676	2,327	794	1,356	3,560	6,554	4,008	2,127

* Subject to revision.

TABLE 2

CARLOT SHIPMENTS OF CABBAGE BY STATES OR DISTRICTS, 1922–1927.
(Data from Bureau of Agricultural Economics.)

States or districts	1922	1923	1924	1925	1926	1927*	6-year average
Total, all states	40,078	37,262	41,115	39,956	40,385	37,998	39,466
Alabama	1,366	1,561	904	1,270	1,586	1,803	1,405
Arizona	1	24	8	19	42	33	21
Arkansas	8	13	2	19	40	36	20
California	738	683	370	644	671	349	575
Colorado	1,889	3,134	1,571	1,396	1,315	695	1,667
Florida	3,002	1,225	3,796	1,933	1,701	1,030	2,114
Georgia	151	105	50	91	66	58	87
Illinois	144	289	279	198	195	186	215
Iowa	560	391	542	267	461	433	442
Kansas	12	9	30	63	67	71	42
Kentucky	73	85	107	45	17	24	59
Louisiana	349	449	95	646	333	595	411
Maryland	448	219	510	238	166	293	312
Michigan	871	705	669	583	286	321	572
Minnesota	1,156	981	1,555	909	1,136	992	1,121
Mississippi	1,629	1,134	605	674	990	710	957
Missouri	16	22	74	140	112	74	73
New Jersey	68	71	43	31	57	55	54
New Mexico	57	48	40	61	172	128	84
New York	9,785	9,121	11,025	13,374	12,412	13,111	11,471
North Carolina	213	364	263	371	347	293	309
Ohio	590	538	656	413	546	753	583
Oregon	4	6	85	40	172	52	60
Pennsylvania	348	310	294	642	511	423	421
South Carolina	3,365	4,327	1,398	3,372	2,695	1,967	2,854
Tennessee	563	270	348	317	609	666	462
Texas	3,996	1,368	7,258	4,024	6,256	5,550	4,742
Utah	28	28	40	89	69	74	55
Virginia	2,944	3,331	3,403	2,213	1,814	2,724	2,738
Washington	99	108	78	89	171	107	109
West Virginia	29	26	25	22	57	39	33
Wisconsin	5,452	6,218	4,903	5,707	5,182	4,274	5,289

* Subject to revision.

Florida; in the Young Island district of South Carolina; in Copiah County, Mississippi; and in the Lower Rio Grande Valley of southern Texas. Table 2 gives the carlot shipments of the important cabbage

TABLE 3

CARLOT SHIPMENTS OF CABBAGE BY MONTHS FOR CALIFORNIA, 1922–1927

(Data from Bureau of Agricultural Economics.)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1922	156	86	115	144	142	69	0	0	10	8	1	7
1923	23	69	186	167	194	27	2	0	1	7	2	5
1924	61	57	62	25	104	12	9	11	11	3	2	13
1925	50	44	79	44	208	105	45	2	9	21	31	5
1926	146	156	174	75	61	30	5	2	4	0	3	15
1927*	54	68	90	41	77	4	4	1	4	2	0	4
Average....	82	80	118	83	131	41	11	3	7	7	7	8

* Subject to revision.

states for the years 1922 to 1927. The total for all states shows that the annual carlot shipments of cabbage for the six year period, 1922–1927, remained fairly constant.

TABLE 4

CARLOT SHIPMENTS OF CABBAGE BY COUNTIES FOR CALIFORNIA, 1925–1927

(Data from Bureau of Agricultural Economics.)

County	1925	1926	1927
Contra Costa	2	0	0
Fresno	1	1	0
Imperial	20	54	85
Inyo	1	0	0
Kern	11	4	0
Los Angeles	215	171	69
Marin	0	2	0
Merced	5	0	0
Monterey	1	24	9
Orange	107	145	65
Riverside	4	1	0
Sacramento	50	18	4
San Bernardino	2	4	0
San Diego	14	1	0
San Francisco	8	19	1
San Joaquin	3	1	0
San Mateo	181	223	104
Santa Barbara	3	8	9
Santa Clara	3	0	1
Santa Cruz	8	1	0
Ventura	7	0	0
Yolo	2	0	0
Total	648	677	347

While cabbage growing in California has not reached the concentration of production that exists in some other states, nevertheless the producing areas are pretty well localized. Table 3 gives the carlot shipments by months for the entire state for the years 1922 to 1927. In table 4 is given the carlot shipments by counties for the years 1925 to 1927. The main districts are around the city of Los Angeles, in the Colma region south of San Francisco, and in Orange County.

SEEDING, TRANSPLANTING, AND HARVESTING SEASONS FOR VARIOUS DISTRICTS

In the Colma district of San Mateo County, cabbage is seeded, transplanted, harvested and shipped during nearly every month of the year. A variety known as San Francisco Market, or Colombo Market, is grown in this district almost exclusively. It is a very distinct type, the head being flat and the leaves especially heavy veined. This variety is very hardy and is noted for its slow habit of growth. The seed is grown locally. The crop is hauled to San Francisco by truck or is shipped to the cities in the interior valleys. Most of the carlot shipments are made from November to March. However, very little is shipped to the eastern markets. Some of the surplus is made into sauerkraut.

In the Salinas Valley district of Monterey County, the time of seeding ranges from June to October; the plants are transplanted into the field from September to December; most of the crop is harvested from January to May.

In Contra Costa County seed for the fall crop is ordinarily planted from July 1 to July 15, and the crop is harvested from October 15 to January 15. The seed for the summer crop is planted from February 1 to February 15, and the crop is harvested from about July 1 to August 31. The Flat Dutch is grown for the summer crop and Copenhagen Market for the fall crop. Most of the crop is sold on the local markets.

In San Diego County, seed is sown from June 15 to August 1 and plants are set in the field from July 15 to September 1. The chief varieties planted are Danish Ballhead and Winningstadt. A portion of the crop is marketed locally; the balance is shipped to points in Arizona, Utah, Washington and other parts of the West. Production is concentrated mainly in the El Cajon, San Diego, and Tia Juana valleys.

In Ventura County cabbage can be grown the year round. Most of the crop is marketed in Los Angeles. Growing is largely localized about Oxnard. The variety usually planted is Winningstadt.

In San Bernardino County production is primarily for the local markets, the surplus going to Los Angeles. There is probably more cabbage imported into the county than is shipped out. Seed for the winter crop is sown about July 15 and transplanted into the field early in September. The crop is harvested during December and January. Seed planted in February will mature a good crop in June. The common varieties are Winningstadt and Danish Ballhead.

In Orange County cabbage is grown as a late fall, winter and spring crop. Most of the carlot shipments are made from January to June.

Cabbage production in Sonoma County is largely localized about the city of Santa Rosa. The local markets and San Francisco take most of the crop. The Early York variety is grown for the early spring crop, maturing in May. Early Flat Dutch is harvested in June following Early York, while Late Flat Dutch is harvested in October, November, and December.

In Santa Cruz County, seeding and transplanting can be done at almost any time of the year. The harvesting season extends throughout the entire year. For the main summer crop, however, the transplanting is done in December and for the winter crop, in August. The principal varieties planted are Early Flat Dutch, Copenhagen Market, Early Jersey Wakefield, Late Flat Dutch, and Danish Ballhead.

In the Sacramento, San Joaquin and Santa Clara valleys seed is sown during June, July and August for the late fall and winter crop and in December and January for the spring crop. The principal varieties are Copenhagen Market, Early Flat Dutch and Late Flat Dutch.

Only a small acreage of cabbage is grown in Tehama County. For the early crop, seed is usually sown in hotbeds in December and the crop matures during May and June. The varieties grown are the Copenhagen Market and Early Flat Dutch.

In Los Angeles County a considerable tonnage of cabbage is shipped throughout the winter, spring and early summer. At present a large portion of the cabbage shipped from Los Angeles County is in cars of mixed vegetables, so it does not appear in the carlot movements. The main shipping season is from January to June. The Winningstadt is the favorite shipping cabbage; the Flat Dutch, Danish Ballhead, and Copenhagen Market varieties are grown for the home trade.

In Imperial Valley, cabbage can be grown during the late fall, winter and early spring. Seeding should be regulated so the plants can be set in the field during October or November. Some of the

growers sow seed directly in the field in double rows on raised beds similar to those used for lettuce. The plants are thinned later to 12 or 18 inches apart. The crop is harvested from February to May. Most of the shipments are made during February, March and April. The principal varieties are Copenhagen Market and Golden Acre.

VARIETIES

It is very important that a variety or strain be selected for planting that grows and produces well in the locality under consideration and at the same time satisfies the demands of the market to which the district caters.

Winningstadt.—This variety is at present the one most extensively grown in southern California, and probably is the favorite variety among the shippers. It has an excellent dark green color, giving it a fresh appearance even after long shipment, and is of the proper size to pack well. It is a solid heading, sharp-pointed cabbage and is very hardy.

Early Jersey Wakefield.—The head of Jersey Wakefield is sharp-pointed. It has a very small head, and except where extreme earliness is essential the Charleston Wakefield or Copenhagen Market is preferred. It does not hold up long after maturity. It is an excellent variety for the home garden but is not grown extensively in California.

Golden Acre.—This is probably the earliest cabbage grown, maturing a few days before the Early Jersey Wakefield. The heads are small, round and very solid.

Late Flat Dutch.—Also known as Premium Flat Dutch and Premium Late Flat Dutch. The head is large and considerably flattened. A late maturing variety but an exceptionally heavy producer; it is not suited for shipment because of its large size. A good type of Late Flat Dutch is shown in Figure 3.

Copenhagen Market.—The Copenhagen Market is a very popular variety and is being planted extensively as a truck crop, market garden crop, and in the home garden. The head is nearly round, solid, and matures at approximately the same time as the Charleston Wakefield, which it is largely replacing in popularity.

Early Flat Dutch.—This is one of the oldest varieties grown in this country. It is a short stemmed variety and has very few outer leaves. It is grown in central California as a late winter and early spring crop.

Danish Ballhead or Hollander.—This is a late variety and is the one most commonly grown for storage purposes. The head is nearly round, solid, of good quality and of a bluish green color.

The shipping and market term "Danish type" refers to all those varieties with hard smooth heads with oval, round or slightly flat shape, and with smooth, tight, broadly over-lapping leaves, such as Danish Ballhead and Cannonball.

Fig. 3.—Late Flat Dutch cabbage. Specimen at the right shows growth habit of the entire plant. Same plant at the left with near leaves removed to show head type.

Scott's Cross.—This is a variety grown to some extent in the Los Angeles district. The variety is said to be a cross between Winningstadt and Flat Dutch. It is a heavier yielder than Winningstadt and apparently tolerates considerable cold and checking in growth without injuring its ability to head.

GROWING THE PLANTS

Plants may be raised in hotbeds, coldframes, or in open beds. The locality and the time of the year that the seed is sown will determine the method to be used.

Growing Plants in Hotbeds.—In the higher altitudes if plants are started during the cold winter months it is often an advantage to sow the seed in hotbeds. The beds should be located where they will be protected from the prevailing winds, and have an abundance of sunlight and good natural drainage. They should be situated so as to have a ready supply of water available. Figure 4 shows the cross section of a hotbed with dimensions and method of filling. The bottom of the pit is 22 inches below the ground line. The north side of the frame should be at least 6 inches higher than the south side. Figure

4 also shows the top view of hotbed, giving dimensions and methods of construction.

Fresh horse manure should be spread uniformly in a compact pile. When heating starts the manure should be placed in the beds. That portion of the pile heating most violently should be placed at the bottom of the bed and the remainder placed on top. Each three or

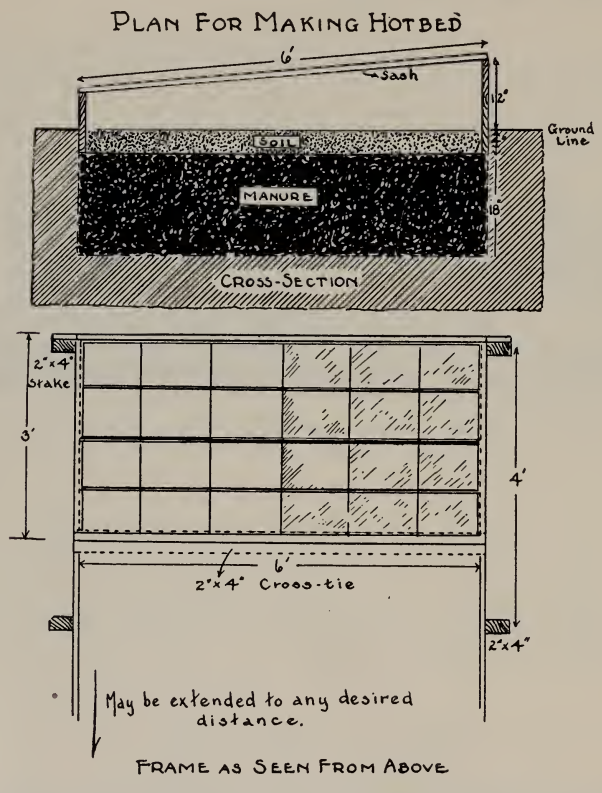

Fig. 4.—Above, cross section of hotbed showing method of construction and filling. Below, top view of coldframe or hotbed, with dimensions and method of construction.

four inches of manure added should be well tramped so as to have the entire mass uniformly packed. A bucket or two of water added to each bed will prevent burning during fermentation. About four inches of soil should be spread over the manure. A sandy loam soil is best; it should be free from large clods and stones, or else it should be sieved through a screen with about one-fourth inch mesh. Within a day or two after placing the manure in the beds it will heat violently but the heating will subside in another day or two. Seed should not be planted until after the first violent heat is over. When

the temperature has receded to 85°–80°F. the seed can be planted. It is best to plant the seed in rows three to four inches apart and one-fourth to one-half inch deep. Seed should be scattered thinly in the row as this guards against a weak, leggy plant and lowers the seedling mortality. After seeds are covered the soil should be tamped lightly or rolled to insure rapid and uniform germination. After watering, the bed should be covered and left until the seedlings are just breaking through the soil, then given plenty of sunlight and ventilation. A too high temperature at this time is likely to produce a leggy, weak plant, subject to damping-off; a tall weak plant is liable to lodge, thus causing a crooked stem to develop and making transplanting difficult. Watering should be done only on bright mornings so that the soil surface will soon dry. It should be done thoroughly but not too often.

The hotbeds may be covered with any material that will hold the heat in the bed and protect the bed from beating rains. Glass sash, muslin or other material may be used. A medium weight muslin is much cheaper than glass and seems to give satisfaction in most sections of California. The coverings of the beds should be removed during warm days and entirely removed a week or ten days before the plants are set out in the field. Water should be withheld to some extent the last week or ten days before transplanting, as this also helps to harden the plants and make them better able to withstand the shock of transplanting.

Growing Plants in Coldframes.—The coldframe is much more commonly used in California for growing early cabbage plants than is the hotbed. In most sections, even during the winter, the weather is so mild that cabbage plants can be started if the frames are located in a protected place and covered with glass or muslin. The plants grown in coldframes are usually more vigorous, stockier and hardier than those grown in hotbeds. The coldframe is similar to hotbed except that no excavation or pit is dug and there is no bottom heat. The frame rests directly on the surface of the ground. Figure 4 shows top view of coldframe with dimensions and method of construction. The seed germinates more slowly in the coldframe than in the hotbed and it takes a little longer for the plant to reach the transplanting stage.

Growing Plants in Open Beds.—In most sections of California, and during most of the year, the plants are grown in open beds. If they are grown during the warm season the seed is often drilled in beds in the open field. If grown during the winter, the seed bed is located in a more or less protected place. Wherever possible the

seeding is done in the open field on a good sandy loam soil of medium fertility. Land for the seed bed should be well leveled, irrigated if necessary, plowed and then put into a finely pulverized condition. The two types of open field beds generally used are the sunken or panel bed, and the raised seed bed. Where the soil is light and porous and not subject to packing, sunken seed beds are preferable. The

Fig. 5.—Cabbage plants of the proper size for transplanting.

latter are prepared in long narrow lands, 12 to 16 feet wide, with small levees on each side to facilitate irrigation by flooding. On the heavier types of soil that form a thick crust after irrigation, raised beds similar to those used for the growing of lettuce have been found more satisfactory. The raised beds are usually about 6 inches high and 18 inches wide, with irrigation furrows between. Each bed has two rows of plants, which are spaced 10 to 12 inches apart. Twelve to 15 pounds of seed is sufficient to plant one acre of seed bed, which in turn will produce enough plants for setting 20 to 25 acres. Seed is

sown with a hand drill sufficiently deep to be in contact with moist soil, but not deep enough to prevent the germinating seedlings from reaching the surface. One-half to three-fourths of an inch in depth is usually sufficient.

The time required for plants to reach the transplanting age varies with the time of the year. During the cooler portion of the year eight to nine weeks are usually sufficient. If the plants are grown during the warm part of the year a much shorter time, approximately six weeks will bring the plants to the proper size. An effort should be made to grow the plants in such a manner as to have a uniform continuous growth. Stunting of the plants in the seed bed is often one of the chief reasons for poor heading and crop failure. In some parts of the state the plants are allowed to remain in the crowded seed bed for a period of twelve to fifteen weeks. The plants then become badly stunted, the stems become woody, the lower leaves turn yellow and drop off, and the plant is slow to start into growth after transplanting.

FIELD CULTURE

Soils and Fertilizers.—Cabbage will adapt itself to a wide range of soil types. Large acreages are grown on muck, clay loam and sandy loam soils. The earliest cabbage is grown on the lighter types of soil that warm up rapidly in the spring. The largest crops are produced, however, on the heavier soils. The cabbage crop should be given liberal fertilization; an application of 10 to 20 tons per acre of well rotted barnyard manure is often made. Commercial fertilizer should be applied providing barnyard manure cannot be obtained at a reasonable cost. The amount and mixture to apply depends upon the original fertility of the soil. Ammonium sulfate and nitrate of soda are used to a considerable extent along the coast and in the southern part of the state. These fertilizers are applied in amounts sufficient to add 50 to 100 pounds of nitrogen per acre. Part of this may be applied before planting the crop and the remainder added as a top dressing while the crop is growing. It is almost impossible to lay down rules for fertilizer applications that will hold for the entire state, or even for any large district within the state. The grower should make a number of fertilizer tests on his own farm and determine the most profitable amount to apply and the best formula to use.

Transplanting.—The plants are usually set on the sides or bottoms of furrows, if planted during the dry part of the year. Figure 6 shows the method of planting prevalent in most sections of the state. The number of plants required to plant an acre can be determined

by multiplying the distance in feet between plants in the row, by the distance between rows, and dividing this product into 43,560, which is the number of square feet in one acre. Small acreages are usually planted by hand by the use of dibbles, trowels, spades or the "scandigie." Some of the larger plantings are made by the use of horse drawn transplanters. The distance between plants varies with the variety. Large heads are not especially desirable for shipping purposes and when the larger types are planted for shipping they should be crowded somewhat so that a smaller head will be produced.

Fig. 6.—Cabbage plants when transplanted are placed on the sides of the ridges or in the bottoms of the furrows in the same way as the cauliflower plants shown above.

Cultivation.—The cabbage crop responds to good care; it will not tolerate neglect like some other truck crops. The chief object of cultivation should be to keep the weeds under control. Cultivation should be shallow in order not to destroy the roots that feed in the surface soil. Everything possible in the way of tillage, regulation of water supply, and fertilization should be done to keep the plants in a healthy growing condition, and development should not be severely checked at any time.

Bolting.—In some parts of southern California cabbage seed is often sown late in the fall. Although the plants are set in the field when of proper size, they make very little growth for a period during the winter. Often a high percentage of these plants form seed stems instead of marketable heads. This tendency to produce flowers instead of heads has usually been attributed to a checking of the growth by low temperature. However, it has been shown that the tendency to bolt is at least due in part to hereditary factors. In eastern Virginia

the Copenhagen Market variety cannot be used for the early crop because of its tendency to bolt. Experiments at the Virginia Truck Experiment Station show a difference between strains of Early Jersey Wakefield in percentage of plants forming seed stalks prematurely. Bulletins 37 and 38 of the station mentioned state, "Indications are that certain inherent tendencies in the seed itself contribute to this condition. . . . In the four earliest lots of early Jersey Wakefield an average of 10.9 per cent of the plants went to seed as compared with 21.7 per cent in the four latest heading lots. This correlation between early uniform heading and low percentage of seed stalks has been frequently noted in the commercial fields. The plants which form a small compact head early in the season are less likely to seed prematurely than those which are somewhat open headed and leafy." In Maryland it was found that large over-wintered plants produced more seeders in the spring than small ones. Starting plants late or growing them on poor soil to keep the size small reduces considerably the percentage of seeders.

HARVESTING, GRADING AND PACKING

Growers and shippers should take great care in harvesting and grading their product. Rough handling in harvesting and packing will cause bruises that facilitate the entrance of disease that may cause much loss to the shipper. Most shippers use the standard lettuce crate. The crate should be well packed and given a good bulge to take care of shrinkage due to loss of water in transit. Heads packed tightly are less liable to bruise and injury than when free to move within the crates. Rigid grading is of utmost importance to the California shipper. It is only by placing a superior product on the markets of the eastern, central, and middle western states that we can hope to compete with the districts nearer the large consuming centers. Standard grades have been established to serve as a guide for growers and packers in the grading of their produce and to aid state and federal inspection at the point of shipment and upon arrival at destination.

GRADES

The United States grades for cabbage as issued on October 1, 1924, are as follows:

U. S. No. 1 shall consist of heads of cabbage which are of one type, of reasonable solidity and well trimmed; which are not soft, withered, puffy or burst; which are free from soft rot, seed stems and from damage caused by discoloration, freezing, disease, insects, or mechanical or other means.

"In order to allow for variations incident to proper grading and handling, not more than 10 per cent, by weight, of any lot may be below the requirements of this grade, but not to exceed one-fifth of this amount or 2 per cent may be allowed for decay.

U. S. No. 2 shall consist of heads of cabbage which do not meet the requirements of the foregoing grade.

Size.—"In addition to the statement of grade, any lot may be classified as Small, Medium, Large, Small to Medium, or Medium to Large.

	SMALL	MEDIUM	LARGE
Pointed	Under 1½ pounds	1½ to 3 pounds	Over 3 pounds
Domestic	" 2 "	2 to 5 "	Over 5 "
Danish	" 3 "	3 to 6 "	Over 6 "

In order to allow for variations in sizing, not more than a total of 15 per cent, by weight, of any lot may vary from the size specifications, but not more than 10 per cent may be either above or below requirements for each class. This tolerance is in addition to the tolerance for the grade.

Definition of Terms:—"As used in these grades:

" 'One type' means that all the lot is Pointed, Danish, Domestic, Savoy or Red, as the case may be.

" 'Pointed type' includes such varieties as Early Jersey Wakefield, Charleston Wakefield, Early York, Winningstadt, and others which normally develop oblong, conical or pointed shaped heads.

" 'Danish type' includes such late maturing varieties as Danish Ballhead or Hollander and Danish Roundhead, etc., and such early maturing varieties as Cannonball, Danish Summer Ballhead, etc., which normally develop hard, tight-leaved, compactly formed heads. A head of any such variety even after trimming will appear tight and smooth-leaved around the basal portion and when viewed from the stem end, circular and regular in outline.

" 'Domestic type' includes such varieties as Succession, All Head Early, Flat Dutch and others that are commonly termed Domestic and which normally develop heads flat in shape and less compactly formed than those of the Danish type. The term also includes such varieties as Copenhagen, Glory of Enkhuizen, and others that develop heads roundish in shape but which in solidity of head and storage qualities are similar to the flat Domestic type.

" 'Reasonable solidity' means fairly firm for pointed type cabbage and southern Domestic type cabbage. Northern Domestic type cabbage shall be firm and Danish or Hollander type fairly hard.

"'Well trimmed' means that the head shall have not more than four wrapper leaves attached and any portion of these leaves appreciably injured by worms or other means shall be removed, and the stem shall not be longer than one-half inch.

"'Soft' means loosely formed or lacking compactness.

"'Puffy' means that the heads are very light in weight in comparison to size and have air spaces in the central portion. They normally feel firm at time of harvesting but soften quickly. They are known as 'Balloon Heads' in certain sections.

"'Seed stems' means those heads which have seed stalks showing or in which the formation of seed stalks has plainly begun.

"'Free from damage' means that the head shall not be injured to an extent readily apparent upon examination."

INSPECTION[2]

"In July, 1920, there was established in California a commercial shipping point inspection service carried on by the Bureau of Standardization, State Department of Agriculture. This service employs a corps of experienced, highly trained men who are authorized to inspect and certify to the exact quality and condition of the produce at time of packing and shipping. The demand for this service has increased steadily and its scope and importance has been greatly enlarged. . . . On July 1, 1922, this service was federalized, each inspector being deputized by the federal government, and certificates issued are now *prima facie* evidence in all courts of the United States.

"This inspection service is available in all of the leading vegetable producing sections in the state. The certificate shows the hour and date of inspection, inspection or shipping point, name and address of the shipper and consignee (when given), car initials and number, kind of car and its condition, if a refrigerator the amount of ice in the bunkers; the quantity of the products inspected; description of load and container; condition of pack; sizing, quality and condition of the products; color, grade, remarks. The buyer, therefore, knows the exact quality and condition of the product at the time the car is loaded, although he may be at a considerable distance from the shipping point. These shipping-point certificates are valuable to the grower as they protect his interest in the adjustment of claims or on a declining market. On the other hand, the buyer is assured that he will receive the quality of produce for which he has paid before

[2]Weishaar, L. J., and Rogers, S. S. The successful marketing of California vegetables. California State Dept. Agr. Special Publication No. 32:1–12. 1922.

seeing it. Whenever requested, a telegram giving the substance of an inspection will be sent 'collect' to the buyer or any other interested party, so that the exact condition of a carload can be ascertained before the sale is even consummated."

INSECTS AND DISEASES WITH METHODS OF CONTROL

Cabbage Root Maggot.—It is during the larval stage that the cabbage root maggot does its destructive work. The adult flies lay their eggs on the stem of the cabbage plant near the surface of the ground or on the soil in close proximity to the plant. The larvae are hatched within a few days, the length of time required for hatching depending largely upon the temperature. The young larvae migrate to the stem and roots below ground and there feed upon the epidermis and cortex and often burrow the entire system below ground. The larvae or maggots are white in color and about one-fourth inch in length when full grown. If the plant is badly infested it wilts down and in the majority of cases does not recover. When the attack is light about the only evidence is a decrease in the rate of growth of the plant.

As the root maggot infests many of the mustard crops, such as radishes, turnips and cauliflower, it is desirable to practice a rotation with crops not related to this group. The soil should be plowed and worked during the late fall, winter and early spring to expose and destroy the pupae. Tarred paper disks have been used extensively to prevent the adult flies from depositing their eggs about the plant. The disks should be placed about the plant at transplanting time or at least before the flies start to deposit their eggs.

Corrosive sublimate is now being used in most regions for the control of this pest. The first application must be made 3 or 4 days after transplanting; the second application 9 or 10 days after transplanting, and the third application 19 or 20 days after transplanting. Late applications should not be made because of the danger of poisoning the consumer. Dissolve one ounce of corrosive sublimate in a small amount of hot water, then add water sufficient to make 10 gallons. Pour one-fourth teacup of this solution about the stem of each plant at each treatment. This material is corrosive, therefore should be mixed in wooden or earthen containers. The cost of each application is eight to ten dollars an acre. It will take approximately 200 gallons of solution to the acre for each application.

Cabbage Aphis.—Cabbage aphis infestations are very general throughout the state, not only attacking cabbage but many of the

related Brassicas. The aphis colonies are usually found on the underside of the older leaves and on the young succulent inner leaves. They lower the vitality of the plant by sucking out the juice. When the colonies appear on the edges of the leaf, they cause it to curl inward. They can often be detected by the appearance of yellowish spots on the leaves where the tissue has been injured. The cabbage aphis is kept under control to a certain extent by numerous parasitic enemies, which become most active as the weather becomes warm, and also predaceous insects such as the ladybird beetles and syrphus fly larvae. Hard driving rains also destroy many of these aphis.

A good liquid spray for control of aphis is made up of the following:

Nicotine sulfate (40 per cent)	1 pint
Fish oil soap	5 pounds
Water	100 gallons

As a general thing it is rather difficult under field conditions to obtain a perfect kill with any liquid spray, because of the protection afforded by the leaves. An effort should be made, therefore, to have the spray reach the undersides of the leaves and especially the central ones, for to be effective, the spray must actually come into contact with the aphis.

Dusts containing nicotine sulphate are being used more and more for the control of cabbage aphis. The dust can be blown into and about the plant so that the particles carrying the nicotine sulphate come into contact with every part. The dust that has been found to give the most satisfactory and at the same time the most economical control, is made by using 95 pounds of hydrated lime with 5 pounds of 40 per cent nicotine sulphate. Mixing should be thorough and only sufficient made at one time for immediate use. Mixing can be done in a cider barrel mounted on a frame so that it can be rotated. An opening about six by eight inches is cut on one side of the barrel for a door. This door should be made tight to prevent leakage. Hydrated lime or some other carrier is placed in the barrel. The requisite amount of nicotine sulphate is then poured on top of the lime. For each pound of dust about one-half pound of pebbles ¾ to 1½ inches in diameter is placed in the container. The keg is then rotated at the rate of about 35 revolutions per minute for five minutes. The dust is then poured into a box below the barrel. The box is covered with a screen to catch the pebbles which are put back into the mixer. If the dust is not used at once it should be stored in tight metal containers. The dust should be applied on warm days if possible. When power dusters are used long trailers should be used as

shown in figure 7. On cabbage less than half grown about 30 pounds of dust to the acre will be required, and on more mature plants about 50 pounds to the acre.

It is often good practice to dip the plants in the nicotine solution mentioned above just after removing from the seed bed and then placing them in tight boxes until time for transplanting. This prevents carrying lice from the seed bed into the field. The native Brassicas are very numerous in California. They serve as hosts to the cabbage aphis and therefore should be kept under control.

Fig. 7.—Dusting for control of aphis. The best control is obtained in the seed bed, and in the field, when a trailer is used behind the duster to hold the dust near the plants. (From Agr. Ext. Cir. 11.)

Cutworms.—In some sections, especially on land that has recently been in sod, cutworms destroy many young plants by cutting them off. The best method of control is by the use of poisoned baits. The following formula is recommended:

Bran	25 pounds
White Arsenic	1 pound
Molasses (cheap blackstrap preferred)	2 quarts

The arsenic and dry bran are first thoroughly mixed. The molasses is diluted with a small amount of water and then mixed with the bran to form a moist mash. A crumbly mash is preferable to one that is so wet that it is sloppy. The mash should stand for several hours in order to give the bran an opportunity to take up the arsenic. The mash is then scattered along the rows or near the base

of the plants. It is best to make the application toward evening since the cutworms feed chiefly at night.

Common Cabbage Worm.—The cabbage worm is without doubt the most serious pest with which the cabbage grower in California has to contend. Although it is fairly easy to control, nevertheless the damage caused by this pest on the late summer and fall crops is tremendous. Arsenicals have proven to give the best control. There is a hesitancy on the part of some of the growers to apply lead arsenate or other arsenical sprays because of the possible danger to the consumer. Arsenicals, however, can be used as a control without danger of poisoning, as the cabbage head grows from the inside and all of the leaves that the spray can possibly reach are discarded in the field at the time of cutting and trimming, and by the ultimate consumer in the final preparation for the table. As a result of this fear of using arsenical sprays many other non-arsenical sprays and dusts have been used that have given little or no control, with consequent great loss to the grower. In the young plant the larvae eat the succulent leaves and when the attack is severe often only a network of veins is left. In the older plant, after the head has started to form, the worms often bore into the head, ruining it for market. Some of the most serious infestations take place in the plant beds. Arsenicals can be applied in solution or as a dust. A recommended liquid spray is 1½ pounds of powdered lead arsenate, or 3 pounds of lead arsenate paste, to 50 gallons of water. In order to make the spray adhere and spread out in a thin film over the leaves, 1 pound of common laundry soap should be added to each 50 gallons of solution. The time to spray and number of applications to make depends entirely upon the infestation. Sometimes one or two sprayings at the proper time will be sufficient for the entire season. Again, it may be necessary to spray every ten days or two weeks.

Excellent control can be obtained by dusting with a mixture of 1 pound of powdered lead arsenate and 8 to 10 pounds of air-slaked lime or gypsum (land plaster). The dust can be applied with a power duster, or hand duster; by shaking through a burlap sack or a tin can perforated at one end. The method used depends largely on the size of the area to be treated. Dust should be applied early in the morning while the dew is still on the plants. Figure 8 shows a female specimen of the cabbage butterfly.

Cabbage Looper.—The larva of the cabbage looper is pale to dark green in color, and when walking, the central part of the body forms a loop or arch. Control may be secured by the same methods as that given for the common cabbage worm, though somewhat more difficult.

Diamond-back Moth.—Larvae of the diamond-back moth may also cause injury at times. When mature, it is about three-tenths inch in length and pale green in color. It is active and very irritable. The control is the same as for the green cabbage worm.

Harlequin Cabbage Bug.—The adult harlequin cabbage bug is shining black or deep blue marked with brilliant orange or red. It is about one-half inch long and flattened. The eggs are laid on the plant in double rows, usually about a dozen eggs being present in one cluster. Both the adults and young suck the juice from the leaves; the affected parts then become yellow—wither and die.

Fig. 8.—Female butterfly of the imported cabbage worm *Pontia rapae* (Linn.) enlarged one and one-half times. (After E. O. Essig.)

As it is rather difficult to control these insects with the ordinary contact insecticides, preventive measures must be used. Very good control can be secured by hand picking the adults when they first appear in the field; since they are very sluggish, they can be caught with little effort and dropped into a can of kerosene. When observed, the egg masses should be picked and destroyed also. Where the insects are abundant, trap crops such as kale, and other brassicas, should be planted to precede the commercial crop. The insect can then be destroyed by spraying with kerosene. All weeds, especially those belonging to the mustard family, should be destroyed throughout the year. During the winter they serve as a source of food and also as a means of protection for this pest. The nymphs can be killed by use of a 10 per cent kerosene emulsion, or a whale oil soap solution consisting of 2 pounds of soap to 4 gallons of water. These sprays, however, are not effective against the adults.

Diseases of Cabbage.—Many of the cabbage diseases so prevalent in the eastern and northern cabbage sections of the United States are of little concern to the cabbage growers in California. This is due, no doubt, largely to the fact that cabbage is here produced

Fig. 9.—Cabbage roots showing characteristic swelling caused by nematode worms. (After L. L. Harter.)

mainly during the fall, winter and early spring, when the temperature of the soil and atmosphere is uniformly low.

Nematodes.—The nematode, eel worm, or gall worm, as it is often termed, because of the gall-like growth it produces on the roots of plants, has not been reported as a very serious pest on the cabbage.

Its presence in the tissue of the root causes stimulation of growth in the vicinity of the parasite with resultant gall formation. Nematodes are seldom found in the heavier soil types but are prevalent in soils of a light sandy nature, especially in the southern districts. Infected plants are retarded in growth and have a stunted appearance and when pulled up the roots have the characteristic knotty growths. Cereal and grass crops are resistant to the nematode and should be used in the rotation if the infestation is severe. Iron and Brabham varieties of cowpeas and velvet beans are almost entirely immune to nematode attack, and can be planted as a green manure crop if adapted to the locality in preference to other legumes that are more susceptible.

Care should be used to select a seed bed free from nematodes. An entire field may become infested as a result of the plants becoming infested in the seed bed. Plants should not be imported from localities known to be badly infested with nematodes. Figure 9 shows the appearance of cabbage roots that are badly infested.

Damping Off.—This is a seedling disease prevalent in the seed bed. The common symptom is a shriveling of the stem at the surface of the ground and the falling over and dying of the young plant. This damping off may be caused by a number of different fungi and is most prevalent in seed beds that are crowded, damp and poorly ventilated. In attempting to control this disease preventive rather than curative measures should be used. New soil should be used each year for the seed bed. The light, well drained, sandy loam soils are better than the heavier types. The surface of the bed should be stirred frequently to facilitate drying and air circulation. The bed should be located where it will get plenty of sunlight and ventilation. On cloudy days the beds should not be watered; on bright days they should be watered early in the morning. Waterings should be thorough, but not too frequent. The rows of plants should be far enough apart to allow a good circulation of air and to permit the sun's rays to strike the soil.

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